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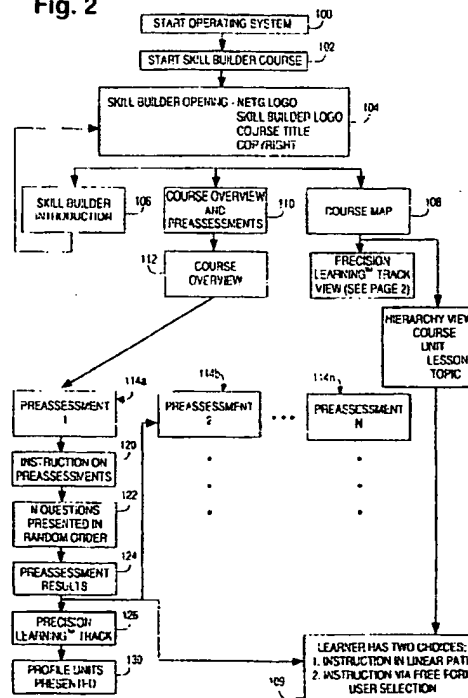
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(54) Interactive learning systems

(57) A computer method of automatically providing a paperless, individualized, learning sequence includes the step of storing in a computer-readable database a plurality of questions directed toward assessing an individual's understanding of a selected learning objective for each member of a plurality of different learning objectives. Next, the individual is automatically evaluated by randomly and sequentially selecting from the database at least one question associated with each member of the plurality of learning objectives and displaying each selected question to the individual for a response, wherein each response is received and evaluated relative to a predetermined standard before the next question is selected (step 122). Next, at least some of the results of the evaluations are accumulated in a computer storage unit in computer-readable form (step 124) and the results processed to automatically produce a specific sequence of instructional units in response to those responses which varied materially from the respective standard (step 126). Finally, the sequence of instructional units are presented on a display for the individual (step 130) wherein the individual can interact with each of the units via the display.

Fig. 2



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**Description**

Computer-based interactive learning systems are known. One particular example is described in U.S. Patent No. 5,395,243 to Lubin et al. entitled Interactive Learning System and which is Assignee to the Assignee hereof. The specification and figures of the Lubin et al. patent are incorporated herein by reference.

Lubin et al. describes a computer-based interactive learning system wherein a user can be assisted in learning how to use a pre-written application program. Typical application programs include word processing or spread sheet operation or operating systems. Lubin et al. describes three different learning paths. One of the learning paths is a preset lesson path in which the user goes through a sequence of audio visual lessons relating to various predetermined features of the application program being studied. Upon completion of the lesson sequence, the user is then given an opportunity to work with the actual application program to re-enforce the previously provided instruction.

In a second learning path, the user may independently select a topic relating to an aspect of the application program which is being studied. The user will then receive audio/visual lessons and/or electronically displayed material relating to that topic.

In a third learning path, the user is able to execute the application program without receiving any training of the type provided by Lubin's system. During this sequence however, the user may access various help files which can present electronic textual reference information relating to that application program while the program is running. This process can be carried out without having to exit the application program.

The above-described types of learning paths have been found to be useful and effective for many users. Lubin's system, however, did not incorporate any capability to evaluate a user's level of skill prior to executing any of the learning paths. It would be desirable to be able to combine systems of the type taught by Lubin with a fractional capability to take into account a user's initial level of skill, if any.

Thus, there continues to be a need for interactive learning systems which take into account a user's initial skill level. It would also be desirable if a user were able to combine lesson elements to create an individualized learning experience apart from any pre-established learning paths.

According to an embodiment of the present invention, an interactive learning system and method are provided and can be used for learning a selected, pre-written program. Preferably, a paperless, individualized, learning sequence can be developed and presented to the respective user for the purpose of improving a user's skill and understanding with respect to given subject matter.

An apparatus embodying the present invention may incorporate a prestored, machine-readable database having a plurality of questions or exercises which are directed toward assessing the individuals understanding of a selected learning objective. Pluralities of questions may be provided for each member of a plurality of different learning objectives.

The apparatus may carry out an automatic evaluation of the individual by sequentially selecting from the database at least one of the questions or exercises associated with each member of the plurality of learning objectives. The selected question or exercise may be displayed for the individual who in turn enters a response. Each of the responses that is received may be evaluated relative to a predetermined standard before the next question is selected.

The system may accumulate the responses and the results of the evaluations for subsequent processing.

The apparatus may in turn produce from the results of the evaluations a sequence of instructional units, based on those responses which varied materially from the respective standard which are intended to improve the user's skills on an individualized basis. The sequence of instructional units can then be presented on a display, for example, for the individual. The individual can then progress through the sequence of units so as to improve selected skills in response to the prior evaluation.

In one embodiment of the present invention, subsequent to completing execution of the sequence of instructional units, the user can then go through a post-learning evaluation or test for comparison purposes.

In yet another embodiment of the present invention, a user can select from among a number of object elements to independently create a personalized learning experience. At a first level, topic-type object elements can be selected which contain, for example, a single objective and an assessment capability. At a higher level, lesson-type object elements can be selected. The lesson-type object elements incorporate a plurality of related topic-type object elements.

In another embodiment of the present invention, at yet another level, unit-type object elements can be selected. The unit-type object elements may incorporate a plurality of related lesson-type object elements.

In yet another embodiment of the present invention, learning-type objects can be grouped together and associated because they incorporate related subject matter or one functions as a prerequisite to another. Similarly, unit-type objects can in turn be associated with one another because they incorporate related subject matter or because some of them represent prerequisites for others.

Reference will now be made, by way of example, to the accompanying drawings, in which:

Fig. 1 is a block diagram of a system embodying the present invention;

Fig. 2 is an overall flow diagram of the process of creating an individual learning profile;  
 Fig. 3 is a more detailed flow diagram of one aspect of the process of Fig. 2;  
 Fig. 4 is a more detailed flow diagram of another aspect of the process of Fig. 2; and  
 Fig. 5 is a flow diagram of a process of selecting learning objects for the creation of a personal learning experience.

While this invention is susceptible of embodiment in many different forms, there are shown in the drawings and will be described herein in detail specific embodiments thereof with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the specific embodiments illustrated.

Figure 1 illustrates an interactive learning system 10 which incorporates a plurality of components. The system 10 includes a control unit 12, 12 are read-only memory 14 and read-write memory 16 which communicate with the processor 12 via a bidirectional bus structure 18. The memories 14, 16, as is known in the art, can be used to permanently or temporarily store constants, programs being executed, or related data.

Also coupled to the bus 18 is a monitor, such as a CRT-type display 20, loud speakers 22, magnetic disk drive 24, CD-Rom Drive 26 and a user input device 28. The user input device 28 could be a keyboard, or alternatively a mouse.

In addition, a local area network (LAN) interface 30 enables the system 10 to communicate with the local network. Further, a remote network interface 32 provides bidirectional communication with the Worldwide Web or other remote networks either through telecommunications or through other forms of data transmission without limitation.

In normal operation, programs can be stored on and read from disk drive 24 or CD-Rom drive 26. Graphics can also be read from the CD-Rom drive. Both the disk drive 24 and the CD-Rom drive 26 can be used as sources from which databases can be accessed.

During normal operation of the system 10, visual information in lessons can be displayed on the display unit 20, under control of the processor 12. Text and graphics can be read from disk drive 24 or CD-Rom drive 26 for the purpose of displaying same to the user. As will be discussed subsequently, a control program for the purpose of carrying out the interactive learning process can be stored on one or both of disk drive 24 or CD-Rom 26 for access by processor 12. Processor 12 is thus able to carry out a prestored process which provides for individual assessment of a user's skills prior to the user going through the interactive learning process.

Figure 2 is a flow diagram illustrating various steps of a method embodying the present invention. In a step 100, the operating system for the system 10 is started. In a step 102 execution of the interactive learning system application program, of a type, for example, described in Lubin but for use with an icon-driven operating system such as available under the Trademark Windows 95 is started. In a step 104 the learning system carries out an initial sequence of displaying titles and related text. When the system exits the initiating step 104, the user can select an introduction in a step 106 or can elect to turn directly to the course associated with the system in a step 108.

In a step 110, a user can enter a course overview and pre-assessment testing sequence. After passing through a course overview in a step 112, the user enters the beginning of a plurality of pre-assessment sequences indicated generally at 114A, 114B...114N. The steps of a selected pre-assessment sequence are similar so a description of the sequence 114a will also describe sequences 114B...114N.

In a step 120, instructions are presented on the display 20 for the user as to how to carry out the pre-assessment process. Subsequently, in a step 122 a plurality of questions or exercises are displayed, one at a time, in random order on the display 20. The user responds to each of the questions or exercises using the keyboard or mouse 28 and the responses are stored by the processor 12. In a step 124, the responses are compared to a pre-established standard, also stored in the disk drive 24 or the CD-Rom drive 26 to assess the performance of the user. For example and without limitation, if questions are presented to the user, they can be ranged so as to have right or wrong answers or to have more preferred vs. less preferred answers which can be in turn reflected in the pre-stored standard. The correlation between the answers received from the user during the step 122 and the appropriate or desirable answers as reflected in the prestored standard, provides a basis for establishing a quantitative assessment of user performance. Subsequent to the step 124, if an individualized learning profile is to be produced based on the sequence 114a, that profile is then produced in a step 126. Subsequent to the step 126, the learning units can be presented to the user in a step 130 discussed subsequently.

If desired, prior to generation of the individualized learning profile in the step 126, additional pre-assessment sequences 114B...114N can be executed to provide a composite learning profile.

Figure 3 illustrates in more detail the generation of the individualized learning track as illustrated in the step 126. Test items 1-1...1-N to be presented in the step 122 are prestored in one of the disk drive 24 or CD-ROM drive 26. In the step 122a, one of the test questions or exercises is selected and presented to the user on the display 20. The answer or response received via the input device 28 is compared to a previously-stored answer in a step 122b. If the answer is unsatisfactory, the objective associated with the test item and the associated topic are retrieved in respective steps 122c, 122d. At least the associated topic is then added to the individual learning profile in a step 122e. If the question is answered correctly in the step 122b, a determination is made in the step 122f if the testing sequence is

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finished. If it is not finished, the next test item is selected. If the test sequence is finished, either the next text sequence 114b is entered or the learning sequence associated with the individual profile is then executed in the step 130.

Examples of test items follow as Examples 1 and 2. Example 1 illustrates two different matching-type test items. Example 2 illustrates two different process educating test items.

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### Example 1

#### Objective:




10 Identify the Explorer features to view files and folders.

#### Related Topic(s):

Changing the Display  
15 Expanding and Collapsing Folders

#### Test Item 1: (question type = matching)

20 Match the button to the task it performs:

- a:  Displays files as large icons
- b:  Displays file names in a list
- 25 c:  Displays file information for each file
- d: + Opens a folder
- e: - Closes a folder

30

#### Test Item 2: (question type = matching)

Match the feature to the desired outcome.

- 35 a: Arrange by Date Orders file names by last modification
- b: Arrange by Size Lists file names according to their space requirements
- c: Arrange by Type Displays all text documents
- d: Plus Sign Displays the files in a folder
- e: Minus Sign Closes an open folder containing files

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### Example 2

#### Objective:

45 Preview a file using Quick View on the shortcut menu.

#### Related Topic(s):

Quick View  
50

#### Test Item 1: (question type=simulation)

Complete the steps to see a Quick View of REPORT1 DOC using the shortcut menu.

#### 55 Test Item 2: (question type=simulation)

Complete the action to preview a Quick View of Agenda doc using the shortcut menu.  
Figure 4 is a flow diagram illustrating in more detail execution of the personal learning sequence, step 130. Where

the personal learning sequence, created in the step 122e includes a plurality of topics  $T_1 \dots T_N$  the system 10 presents each of the selected topics in a series of steps 130-1...130-N to the user via the display 20. The user can interact with the various presented topics via the keyboard or mouse 28 during the process of going through that particular individualized learning sequence. Subsequent to exiting the learning sequence, the system 10 can present a post-assessment test in a step 132 to determine the level of skill that the user has improved to as a result of the process. A similar set of steps can be carried out to implement the personal learning sequence for each of the units  $U_2 \dots U_N$ .

Hence, when completed, the user will have experienced an individualized learning sequence in connection with one or more of the units 1-N. The user can then exit to the step 109 and enter the application or other program being taught for direct execution or can enter additional course units for further instruction.

Fig. 5 illustrates an overall flow diagram for an alternative approach to creating a personalized learning experience based on collecting together a plurality of separately-accessible learning objects. The learning objects are contained in an accessible database which is organized in several different ways, having both hierarchical and contact-sensitive aspects.

A course object is made up of a plurality of independently-accessible unit objects. Unit objects are learning objects which include a plurality of independent lesson objects. Lesson objects, in turn, are also learning objects which are made up of a plurality of dependent topic objects. Topic objects are dependent objects which contain a single objective and an assessment.

The content of a learning object is illustrated, in an overall sense, in block 150 of Fig. 5.

The lesson object is the smallest independent instructional activity available to a user. A given lesson object exhibits internal cohesion and is focused about a plurality of dependent topic objects.

A lesson object incorporates a plurality of objectives as well as a second plurality of test or assessment items. It also incorporates predefined sequencing and interactions between related, dependent, topic objects.

Lesson objects can be linked with other lesson objects or can stand alone. Topic objects, by way of contrast, are dependent on the associated lesson object and contain only a single objective and an associated assessment.

As illustrated in block 152 of Fig. 5, learning objects can be implemented out of a plurality of linked pages. The pages can be linked together both linearly and non-linearly. Pages can contain text, multi-media components and user interaction logic.

Alternatively, learning objects can be grouped together as a result of content or because one or more serves as a prerequisite for another, as illustrated in element 154 of Fig. 5.

A plurality of learning objects can be selected via a User through an object access program 156. The User can select, via the access program 156, one or more lesson objects to be experienced for the purpose of addressing an education or training objective. Learning objects can be stored on a variety of media such as magnetic disc drives and/or CD Rom drives. The object access program 156 can be accessed by the User not only directly through a local area network but also remotely via the Internet and the Worldwide Web, if desired.

From the foregoing, it will be observed that numerous variations and modifications may be effected without departing from the spirit and scope of the invention. It is to be understood that no limitation with respect to the specific apparatus illustrated herein is intended or should be inferred. It is, of course, intended to cover by the appended claims all such modifications as fall within the scope of the claims.

## Claims

1. A computer based method of automatically providing a paperless, individualized, learning sequence comprising:

storing in a computer readable database a plurality of questions directed toward assessing an individual's understanding of a selected learning objective for each member of a plurality of different learning objectives; automatically evaluating the individual by randomly and sequentially selected from the database at least one question associated with each member of the plurality of learning objectives and displaying each selected question to the individual for a response wherein each response is received and evaluated relative to a predetermined standard before the next question is selected; accumulating at least some of the results of the evaluations in a computer storage unit in computer readable form; processing the results to automatically produce a specific sequence of instructional units in response to those responses which varied materially from the respective standard; and presenting the sequence of instructional units on a display for the individual wherein the individual can interact with each of the units via the display.

2. A method as in claim 1 wherein in storing step, at least some of the questions are linked to a plurality of possible

answers and in the displaying step, at least the selected question and the plurality of possible answers are displayed.

- 5 3. A method as in claim 1 wherein in the storing step, some of the questions are stored in a form which directs the individual to achieve a specified result without specifying the actions to be taken.
4. A method as in claim 1 which includes presenting a performance evaluating test, subsequent to presenting the sequence of instructional units.
- 10 5. An apparatus for providing an automatic, paperless, individualized learning sequence to a user comprising:
  - a programmable processor;
  - a visual display coupled to the processor;
  - 15 a unit coupled to the processor, for reading control information and a database from a medium and providing that information to the processor and wherein, in response to that information, the processor accesses the database and wherein the processor includes circuitry for randomly selecting from the database a plurality of assessment questions and circuitry for presenting the plurality of questions to the user on the display;
  - a user operable input device coupled to the processor, whereby the user provides responses to the processor to at least some of the assessment questions and wherein the processor includes further circuitry for evaluating the responses and in response thereto for establishing a sequence of selected topics for presentation to the user.
- 20 6. A system as in claim 5 wherein the processor includes further circuitry for presenting the sequence of selected topics to the user.
- 25 7. A system as in claim 6 wherein the processor includes further circuitry for reading from the database a post-test and circuitry for presenting the post test to the user.
- 30 8. An individualized, paperless, learning system comprising:
  - a database of different learning objects;
  - a control unit with circuitry for enabling a user to select an individual sequence of learning objects from the database;
  - 35 a display unit coupled to the control unit whereat the control unit is adapted to display the individual sequence of learning objects.
9. A system as in claim 8 wherein the control unit includes circuitry for linking the objects in the individual sequence.

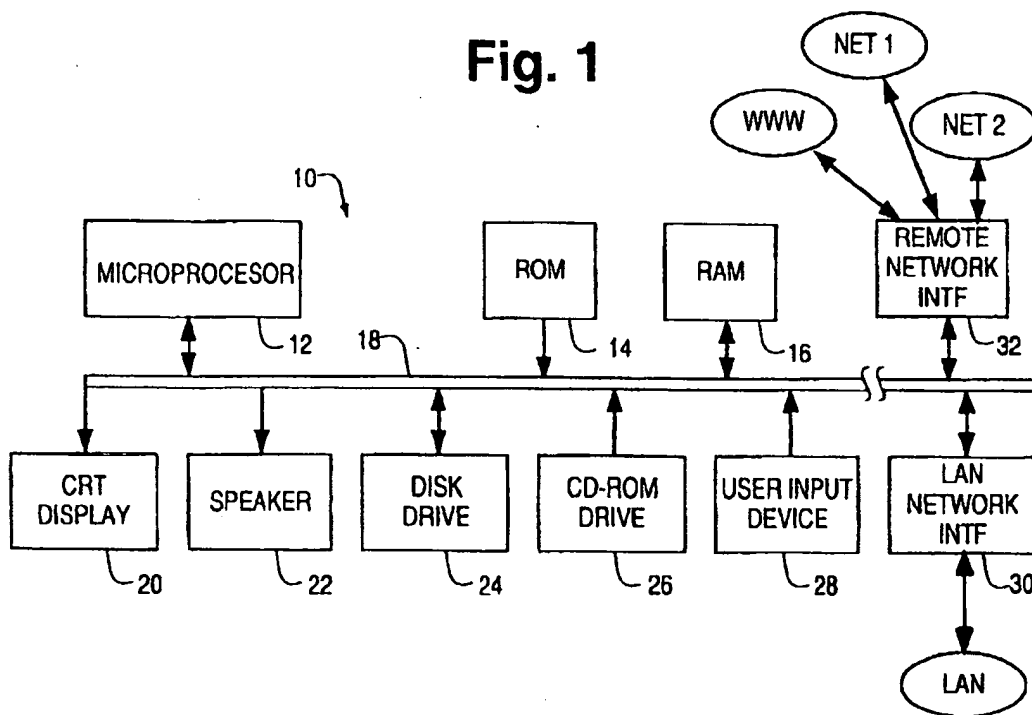
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Fig. 1



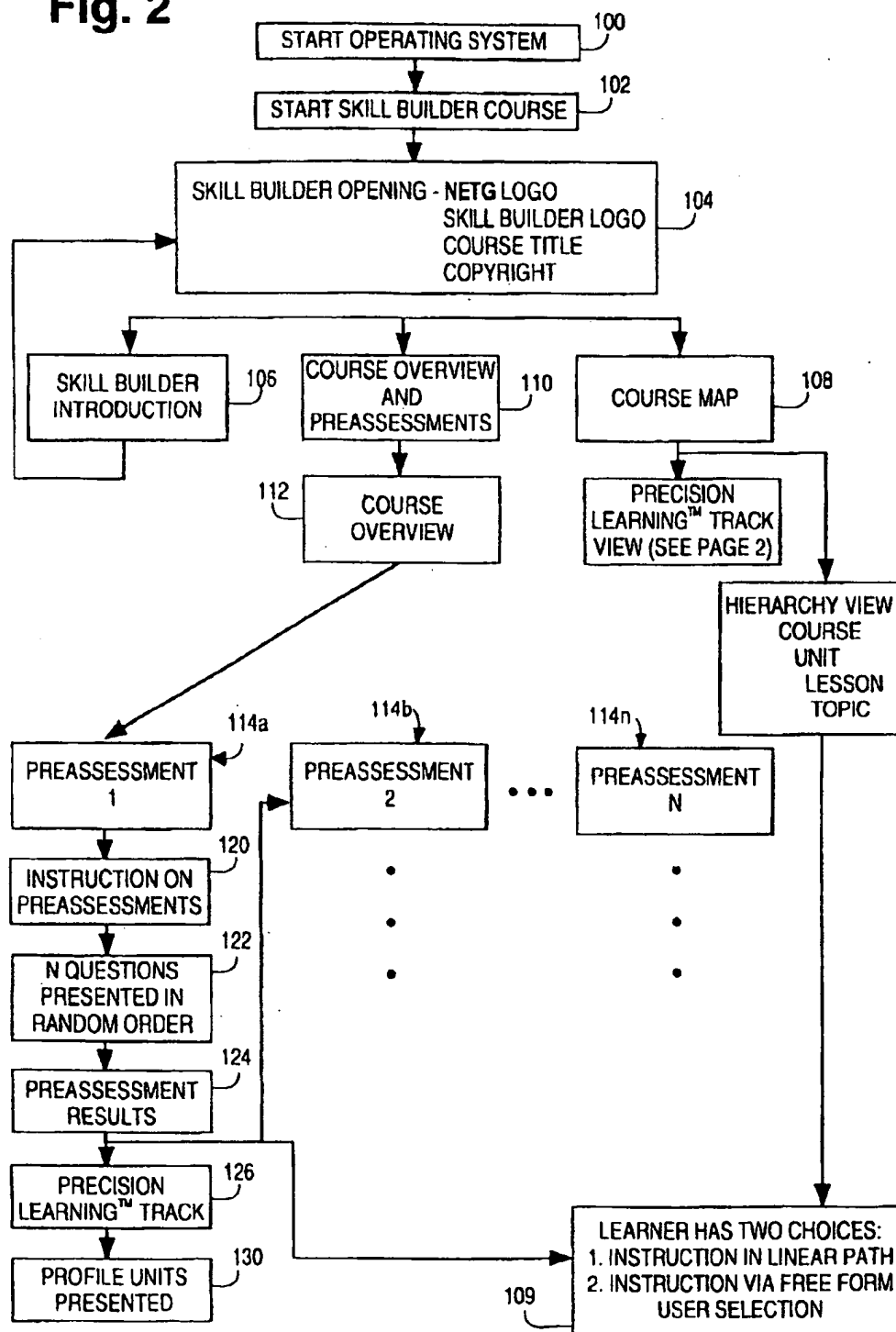
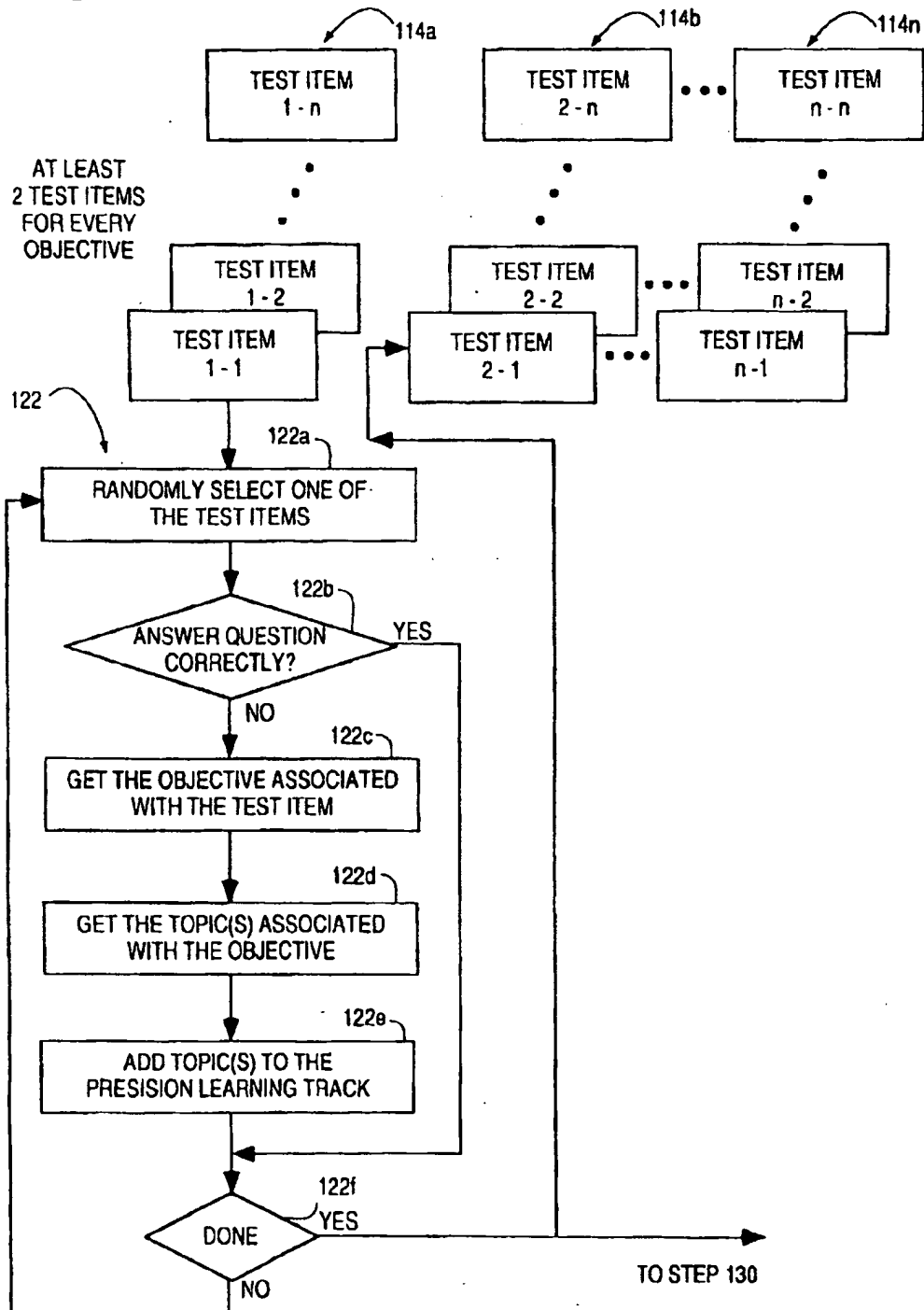
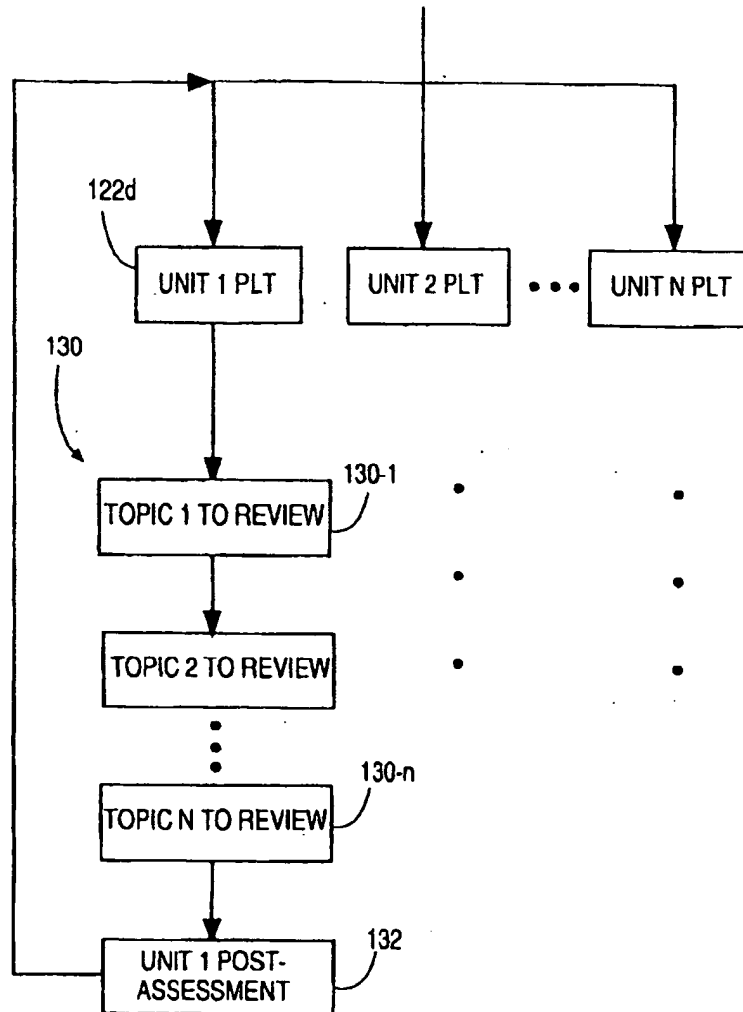
**Fig. 2**



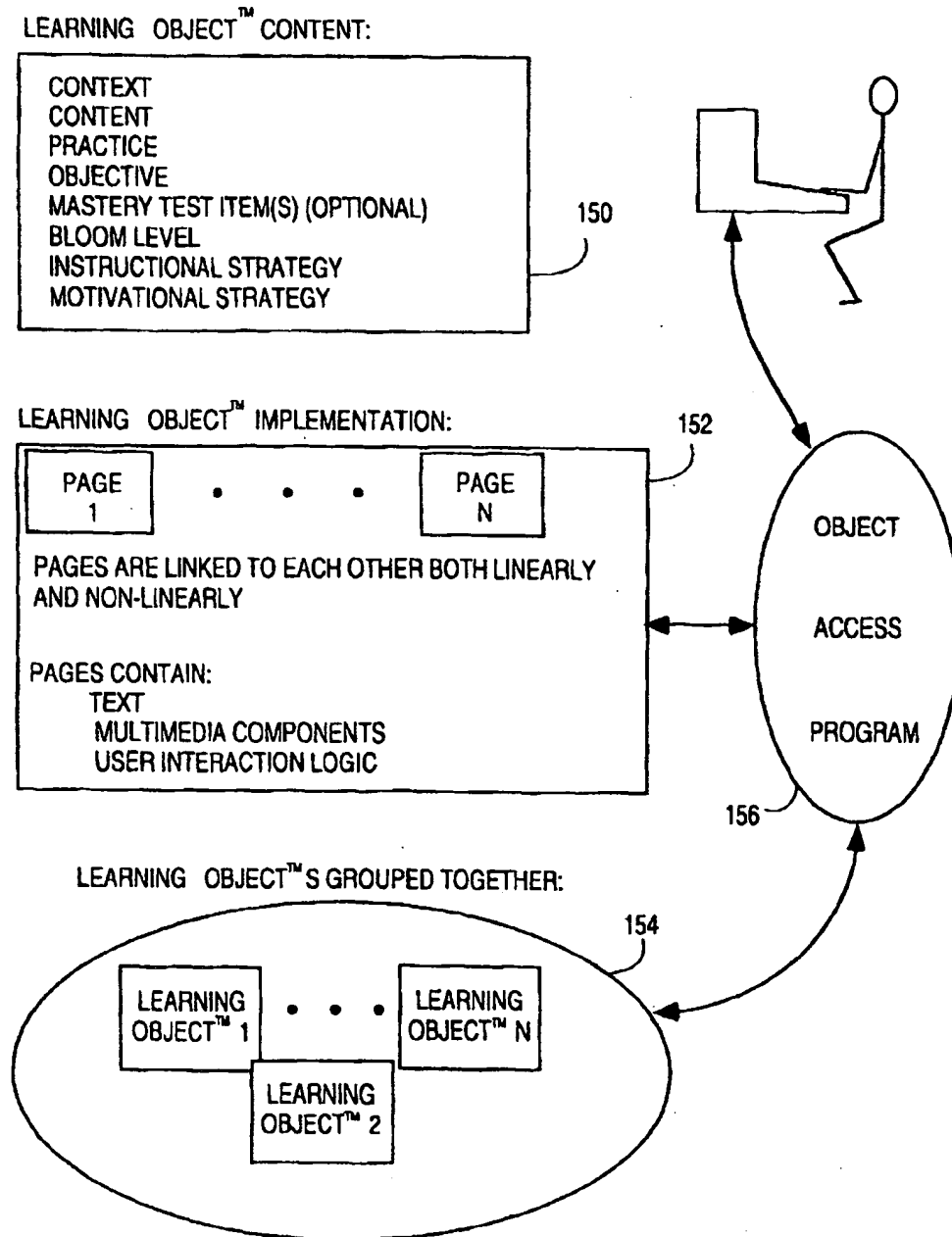
Fig. 3



**Fig. 4**



**Fig. 5**



LEARNING OBJECT™S ARE GROUPED TOGETHER BECAUSE THEY ARE EITHER RELATED OR ONE SERVES AS A PREREQUISITE FOR ANOTHER.

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EUROPEAN SEARCH REPORT

Application Number  
EP 97 30 8489

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document, with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 710 942 A (AT & T GLOBAL INF SOLUTION) * the whole document *	1.4-7	G09B7/04 G09B7/06
X	EP 0 710 943 A (AT & T GLOBAL INF SOLUTION) * the whole document *	1.4-7	
X	US 5 437 553 A (COLLINS DEBORAH L ET AL) * the whole document *	1.4-7	
P,X	US 5 618 182 A (THOMAS C DOUGLASS) * the whole document *	1.2.5	
A	US 5 267 865 A (LEE JOHN R ET AL) * the whole document *	1.4-7	
A	US 5 489 213 A (MAKIPAA JUHA) * the whole document *	1.4-7	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) G09B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 9 February 1998	Examiner Gorun, M
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